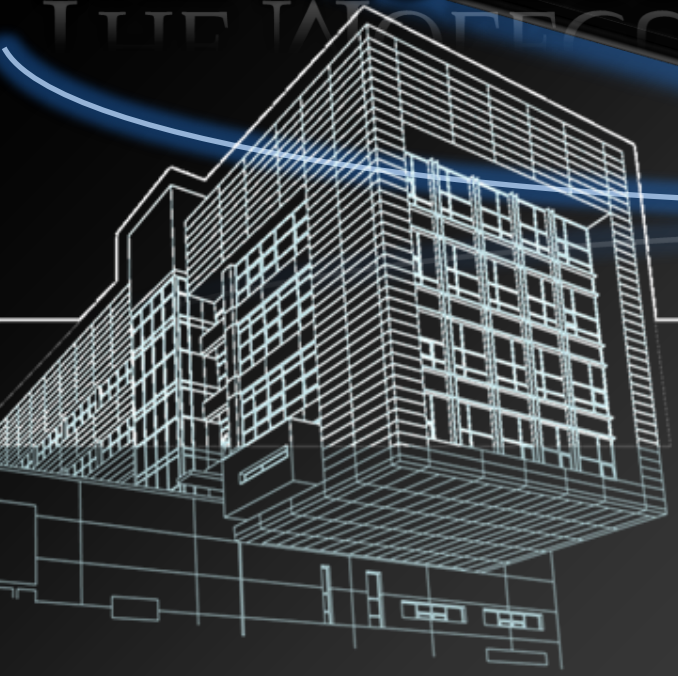
The Molecular Foundry at LBNL



Lawrence Berkeley National Laboratory

The Molecular Foundry

DOE User Programs:

Opportunities for Commercialization

David Bunzow
Molecular Foundry
User Program Manager

Kimberley Tan
Database Administration
Engineering Assistant

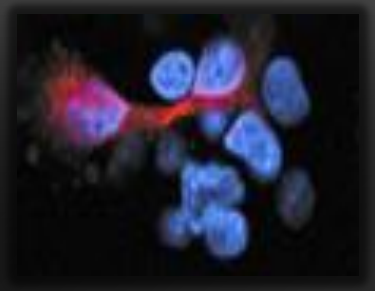
NanoBusiness/NanoManufacturing Summit
September 27, 2011

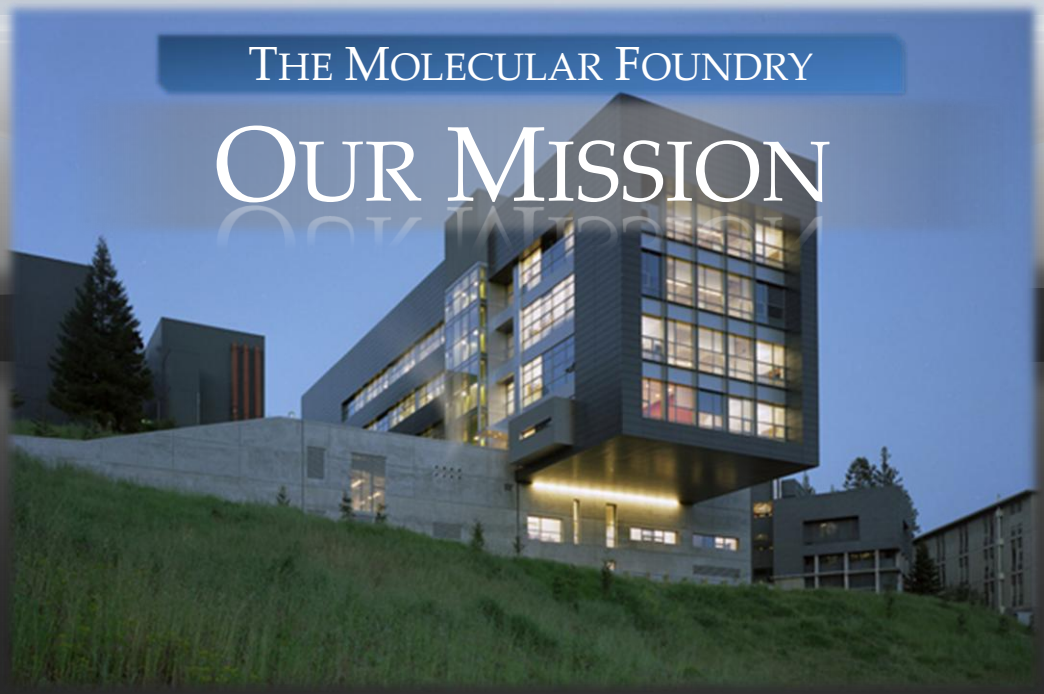
The Molecular Foundry at the Lawrence Berkeley National Laboratory is funded by the U.S. Department of Energy through its Office of Science and Basic Energy Services

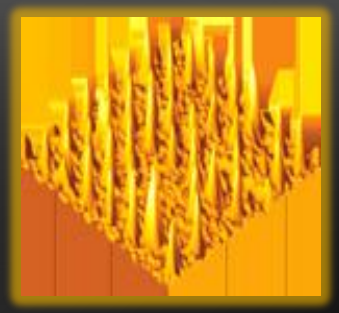
U.S. DEPARTMENT OF ENERGY

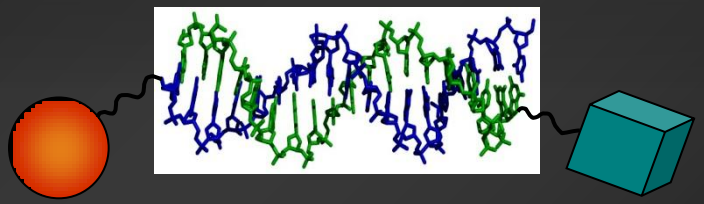
THE MOLECULAR FOUNDRY

OUR MISSION









Through access to State-of-the-Art instruments, materials, technical expertise and training, the Molecular Foundry provides its researchers with the tools to enhance development and understanding of the synthesis, analysis, characterization and fundamental theories of nanoscale materials.

U.S. Department of Energy Nanoscale Science Research Centers

Molecular Foundry

at:
Lawrence Berkeley National Laboratory
Berkeley, CA

access to:
Advanced Light Source
National Center for Electron Microscopy
National Energy Research Scientific Computing Center

Center for Integrated Nanotechnologies

at:
Sandia National Laboratories/ Los Alamos National Laboratory
Albuquerque/Los Alamos, NM

access to:
Los Alamos Neutron Science Center
National High Magnetic Field Laboratory

Center for Nanoscale Materials

at:
Argonne National Laboratory
Argonne, IL

access to:
Advanced Photon Source
Intense Pulsed Neutron Source
Electron Microscopy Center

Center for Nanophase Materials Sciences

at:
Oak Ridge National Laboratory
Oak Ridge, TN

access to:
Center for Neutron Scattering
National Center for Computational Sciences
Shared Research Equipment Collaborative Research Center

Center for Functional Nanomaterials

at:
Brookhaven National Laboratory
Upton, NY

access to:
National Synchrotron Light Source
Laser Electron Accelerator Facility



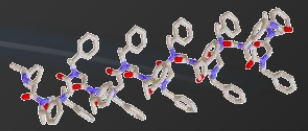


THE MOLECULAR FOUNDRY

RESEARCH THEMES

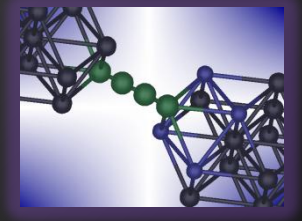
COMBINATORIAL NANO SCIENCE

Robotic synthesis to generate and test large libraries of biological and inorganic nanostructures



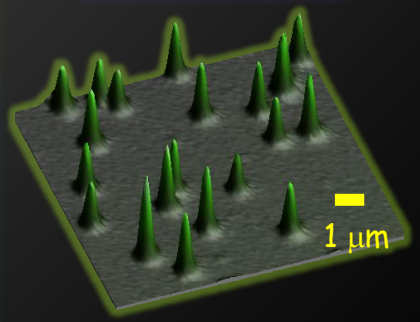
NANOINTERFACES

Analyzing and engineering the properties of hybrid nanomaterials



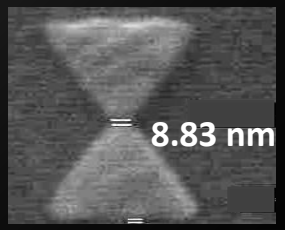
MULTIMODAL IN SITU NANOIMAGING

Applying multiple imaging techniques to investigate dynamic nanoscale phenomena



SINGLE-DIGIT NANOFABRICATION

Fabricating nanoscale structures, features and spaces <10 nm



SIX USER FACILITIES AVAILABLE

Imaging & Manipulation of Nanostructures	Characterization, analysis, visualizations, measurement and manipulation of organic/inorganic nanostructures
Nanofabrication	E-beam lithographic, nano-imprint, ALD, PECVD, ICP and multiple thin-film deposition and etch processing techniques
Inorganic Nanostructures	Semiconductors, spintronics, thermoelectrics, PVs and carbon-based hybrid nanostructures including graphene electronics
Organic & Macromolecular Synthesis	Studies of "soft" materials: organic molecules, macromolecules, polymers and their assemblies
Biological Nanostructures	New bio-inspired materials; peptoids, synthetic biological structures, and novel drug delivery techniques
Theory of Nanostructured Materials	Theoretical support to guide understanding of new principles, behavior sand experimental results

USER PROGRAM DESCRIPTION

Proposals are submitted by potential User teams from throughout US and ROW to Molecular Foundry via our customized database

Users describe what they want to accomplish scientifically, type of proposal (Standard, Instrument Only, Sample Only)

Users request access to Lead/Support facilities equipment and staff capabilities as well as affiliated labs and other LBNL user facilities

Very best proposals within current/projected capacity are awarded up to one year of access time to accomplish their work

Several process variations (proprietary, directors discretion and rapid access) can be requested

Proposals are evaluated internally for capability and effort, then externally for scientific merit by panels of subject matter experts

Work results must be published in open journals (non-proprietary)

Follow-on proposals are encouraged with good previous results

Non-locals and industrial users are strongly encouraged to apply!

DOE NSRC "BUSINESS MODEL"

Encourage cross-disciplinary investigations leading to critical scientific discoveries having high impact on global needs

Basic energy-related research - key to our collective future!

Science for the public good - drives our program, operations & themes

Encourage more non-local user proposals and key collaborations

Shorten the research - development - VC - startup - manufacturing continuum

Attract & encourage greater number of quality industrial users

USER PROGRAM – PROPOSAL REVIEW DETAILS

Call for Proposal Submissions

- 2 formal "Calls" per fiscal year (December/January and June/July)
- 4 week submission window – 14 weeks total process time per call
- Standard; Instrument Only; Sample Only – both proprietary and non-proprietary
- Cost for non-proprietary proposal (staff & equipment) is ZERO!
- Rapid access and industrial user proposal processes available

Internal Feasibility Assessments

- Capacity and coordination with staff and support facilities
- Capabilities of PI and investigators collaboration
- Preliminary EH&S data submission evaluation

External Scientific Reviews

- Academic and industrial reviewers provide multiple perspectives
- SMEs represent academics, government and industries
- Detailed EH&S data submission evaluation

Accepted Project Metrics

- User agreement protects IP
- 1 year to conduct work
- Renewal proposals possible

Proposal Submission Assistance Available!

- http://foundry.lbl.gov
- Review "Becoming a User" features
- Create a User Account

THE MOLECULAR FOUNDRY

USER SERVICES AVAILABLE TO AUGMENT YOUR DISCOVERY & COMMERCIALIZATION

Staff

- Scientist assign to your project
- Additional scientific staff collaborations
- Administrative support for business operations
- User Office always available to address issues

Collaborations

- Select from 1-6 Foundry facilities - all in same proposal!
- Other LBNL user facilities available for selection
- Affiliated labs support for specialized needs
- Distinguished Lecture Series attendance at LBNL
- Weekly Seminar Series (features work by users)
- Membership in Foundry Users Association (TMFUA)

Equipment

- Dedicated and state of the art for users
- foundry.lbl.gov/six/ index.html
- Scheduling services available

USER SERVICES AVAILABLE TO AUGMENT YOUR DISCOVERY & COMMERCIALIZATION

Training

- User training provided on select pieces of equipment
- Lab specific OJT safety and process training

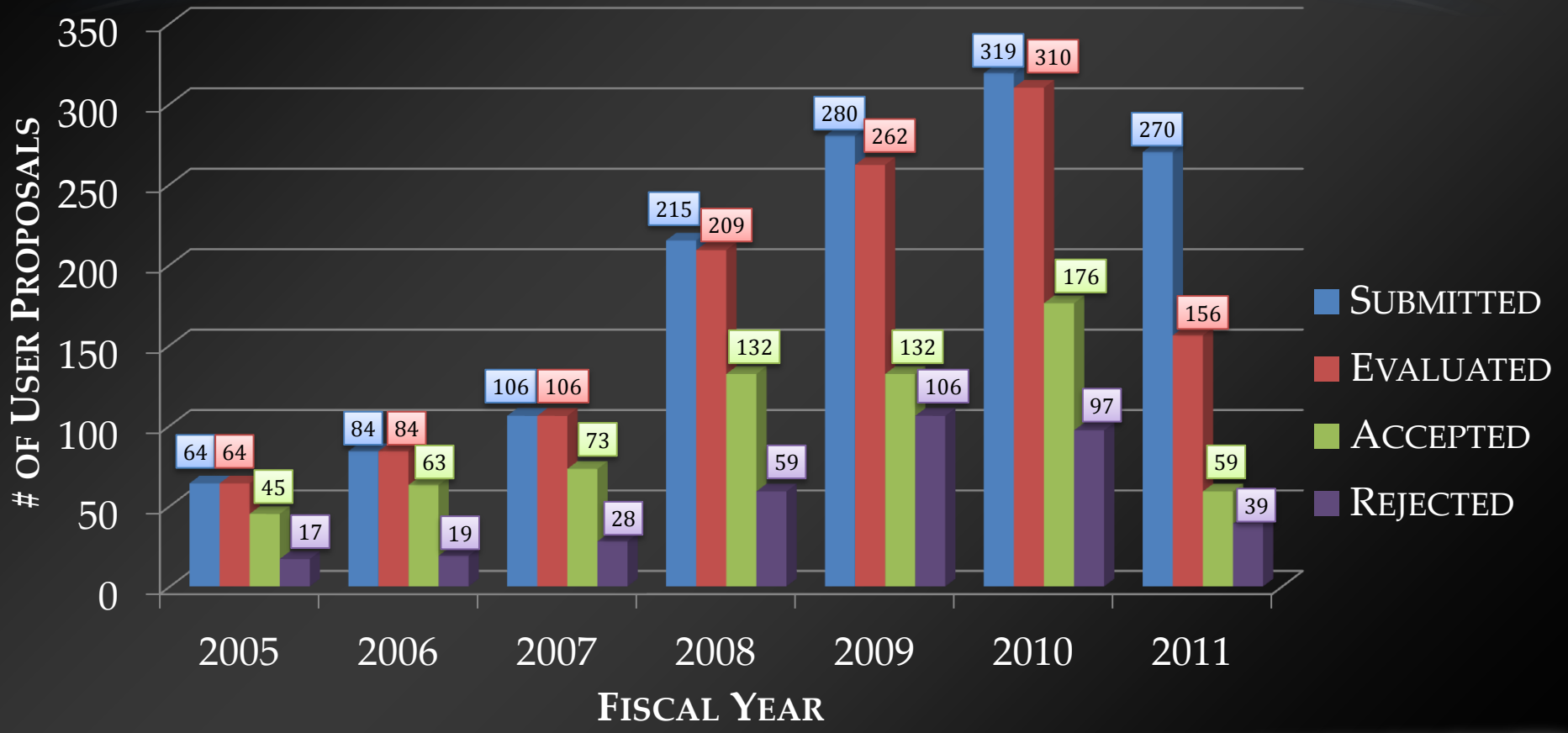
User Resources & Services

- Cubicle spaces assigned
- Wireless and telecom included
- Office supplies provided
- Copy/scan/fax/internet provided
- Badging and Foundry-specific lab access

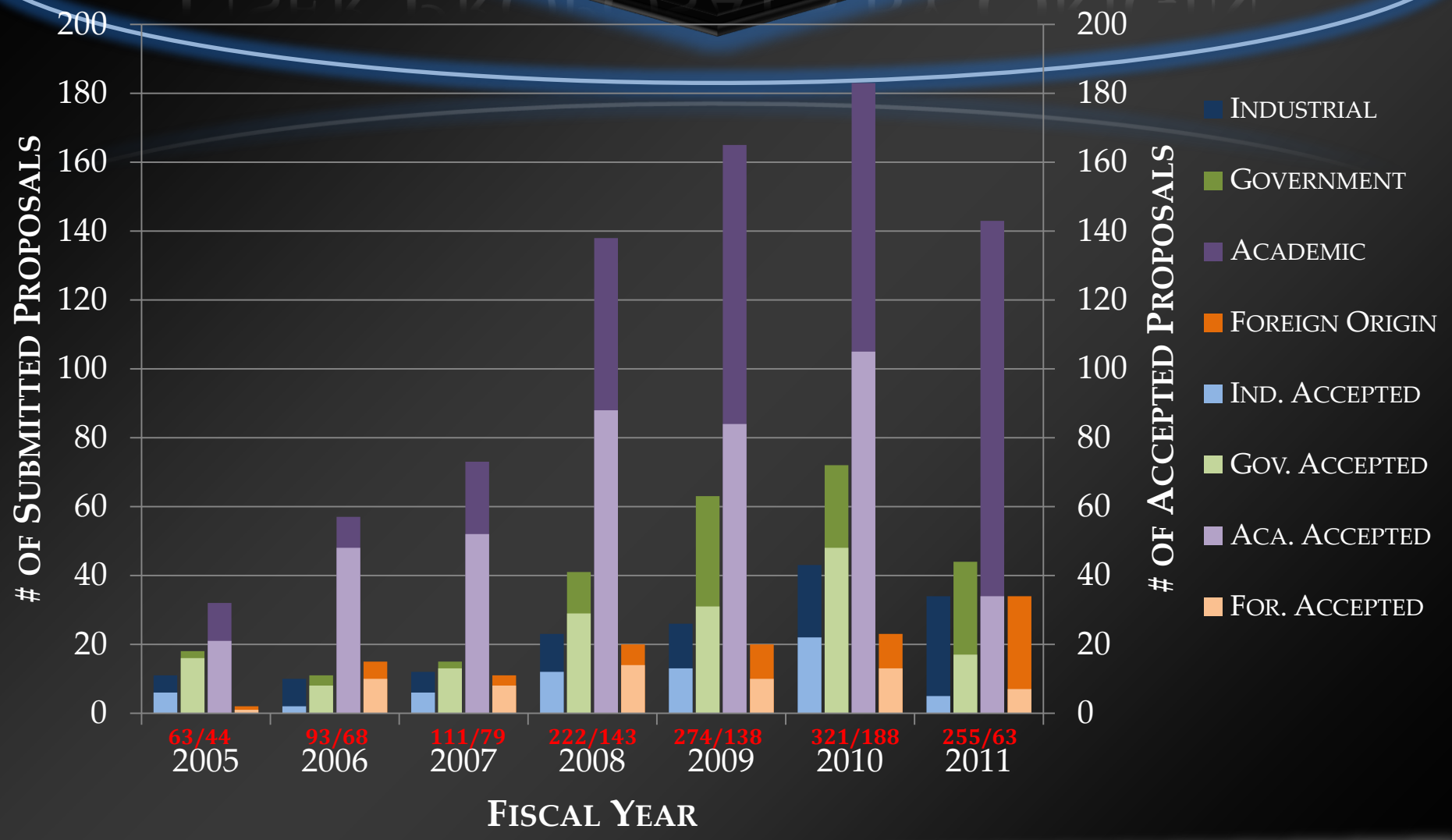
Documentation

- User agreements negotiation and process
- Material Transfer Agreements
- CRADAs and WFOs
- Proprietary process (data in and data out) options

USER PROPOSALS WORKLOAD



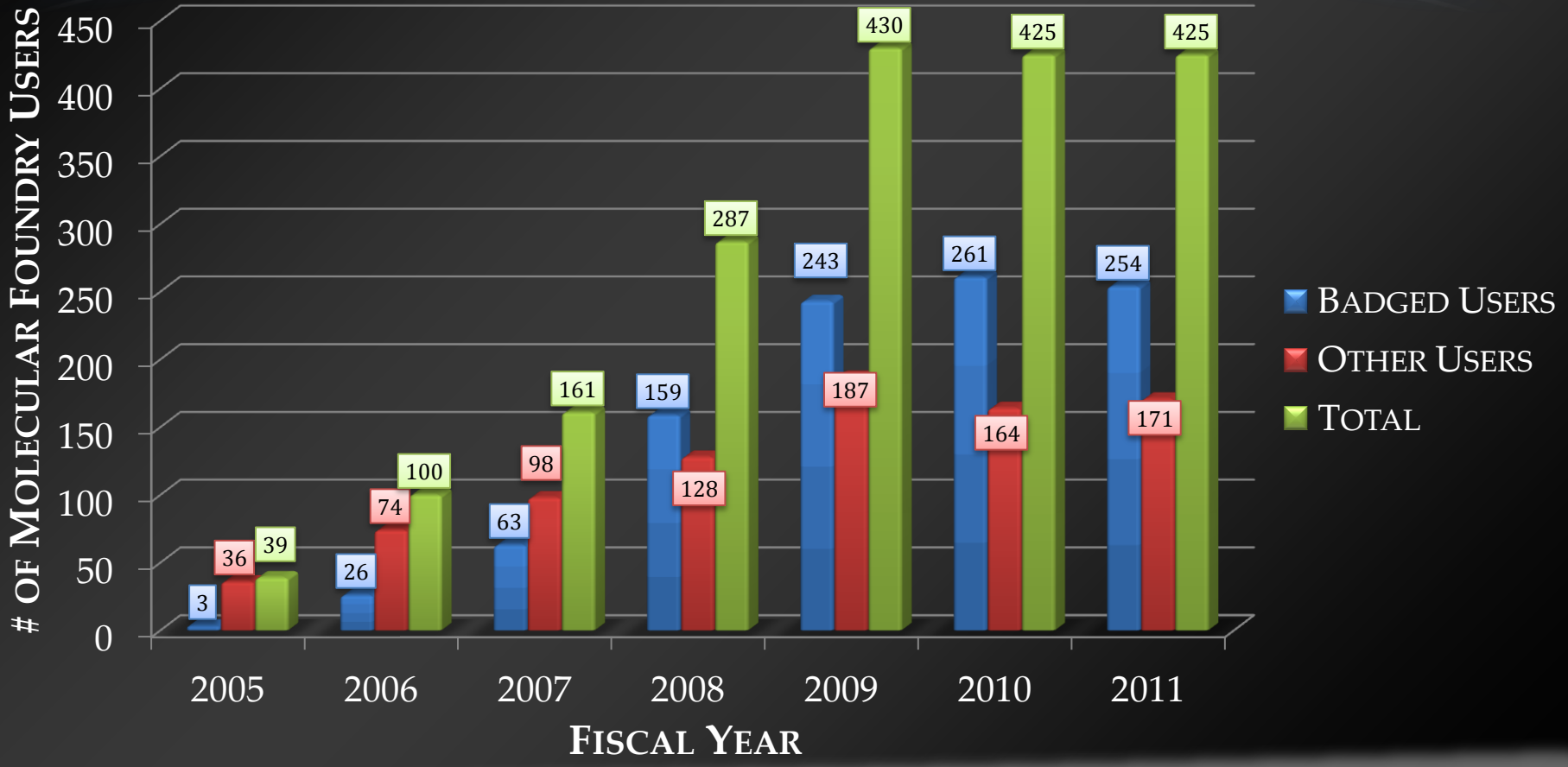
USER PROPOSALS BY ORIGIN



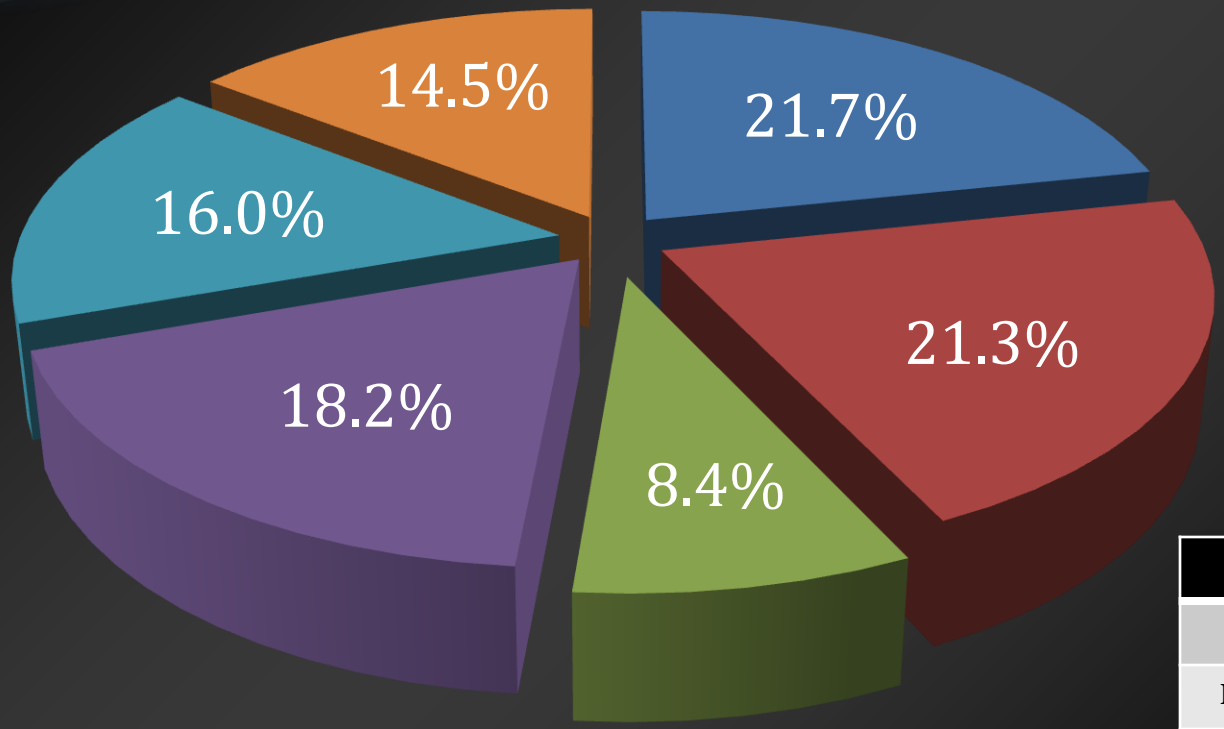
LBNL'S REMARKABLE HISTORY OF INNOVATION & COMMERCIALIZATION

Since 1931, Lawrence Berkeley National Laboratory, a U.S. Department of Energy laboratory managed by the University of California, has convened teams of scientists to tackle the most urgent challenges of the day. Their work has saved lives, generated jobs, reduced energy costs by billions and sparked the imagination of several generations. That same commitment to new technologies for a changing world continues today.

NUMBER OF UNIQUE USERS

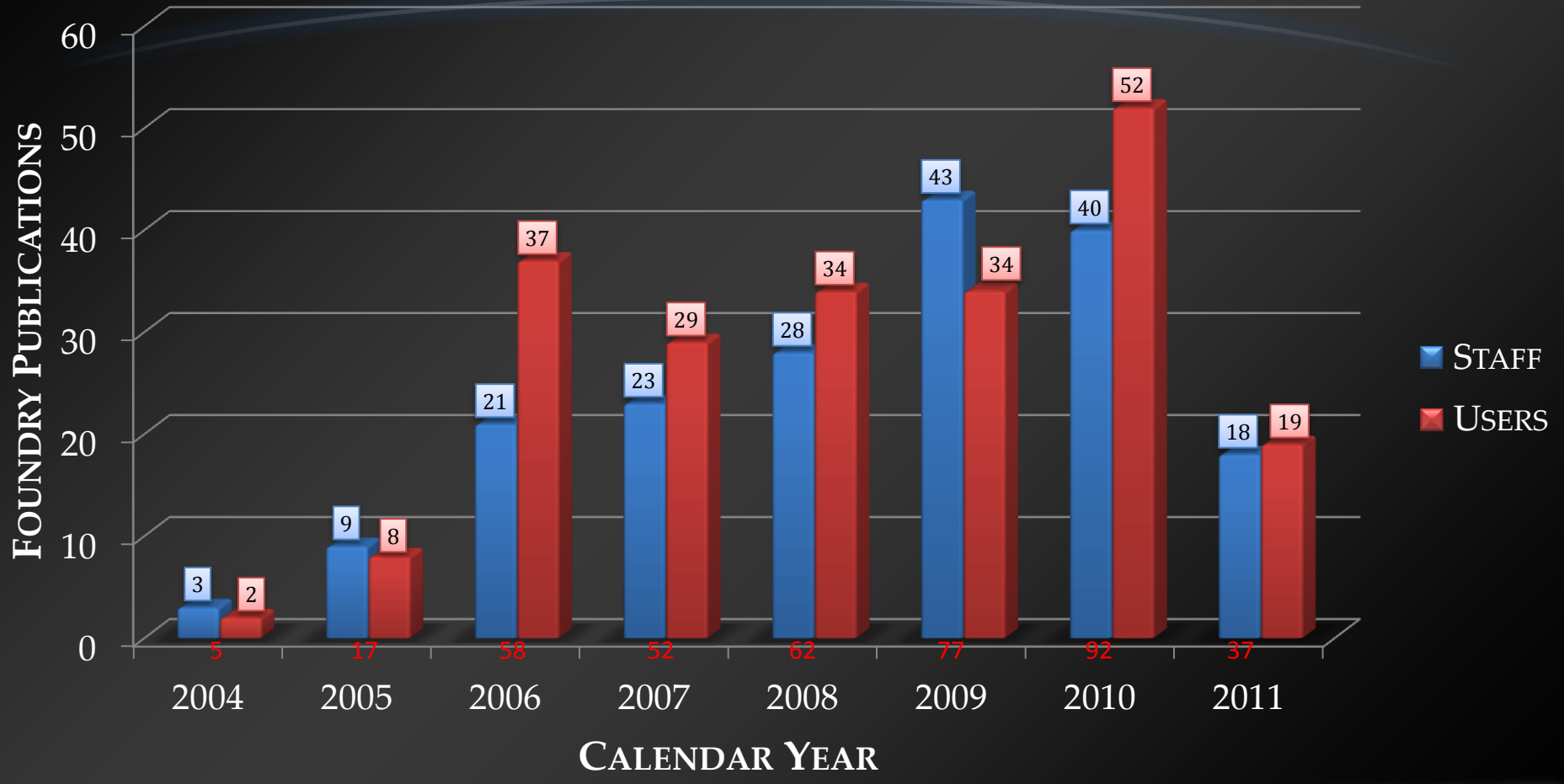


SUBMITTED PROJECTS BY LEAD FACILITY

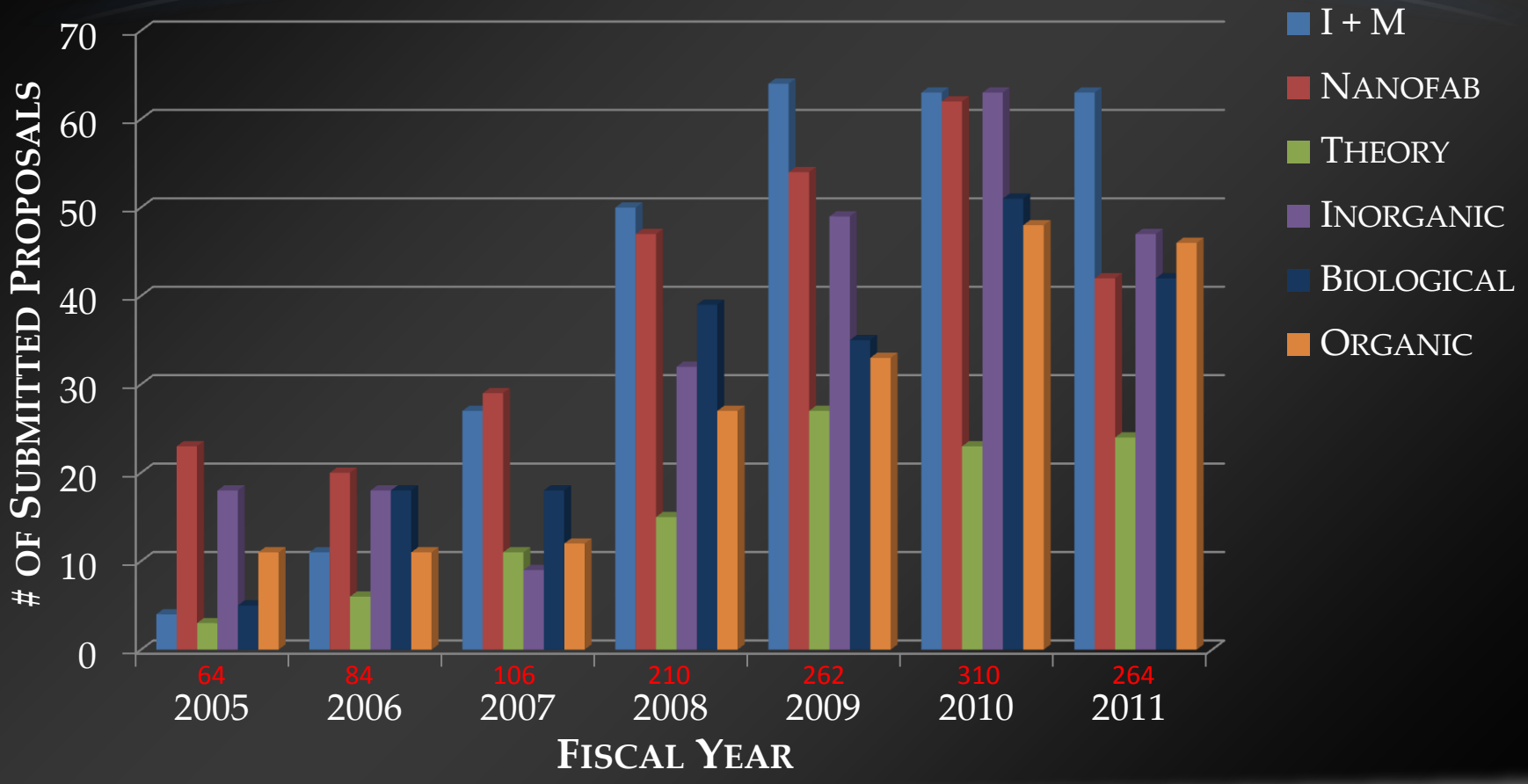


Type	#	%
Standard	1118	5.3%
Instrument	113	8.7%
Sample	69	86.0%
Proprietary	36	2.8%

PEER-REVIEWED PUBLICATIONS



USER PROJECTS BY LEAD FACILITY



REVIEWED PROPOSALS BY LOCATION

United States of America	1175

State	#
CT	5
DC	1
DE	5
MA	25
MD	3
NJ	8
RI	1

Country	#	Country	#
Australia	10	Italy	22
Austria	3	Japan	2
Belgium	2	Netherlands	3
Canada	3	Pakistan	1
China	4	Singapore	6
Denmark	2	South Korea	3
Finland	1	Spain	7
France	8	Sweden	5
Germany	17	Switzerland	1
India	2	Taiwan	1
Ireland	2	United Kingdom	16
Israel	2	Others	2

International	125

NANOTECHNOLOGY BUSINESS COMMERCIALIZATION THRUSTS

Quantum Computing - nanophotonics, qubits, spintronics, what if…

Energy Conversion Strategies - photovoltaics, OLEDs and thermoelectrics

Novel Materials - MOFs, CO2 sequestration, metamaterials, H2 lattices

1D/2D Graphene - Moore's law extension must continue!

Undergrad Education - prepare next generation for science careers

Synthetic biology - nanostructures and novel medical applications

Nanomanufacturing - travelling long road from research to financial success together

THE MOLECULAR FOUNDRY

TMF – INDUSTRIAL COLLABORATION

AN ONGOING SUCCESS STORY!

Company Profile

Company Name:	aBeam Technologies, Inc.
Location:	Castro Valley, CA, USA
Status:	Ongoing LBNL User
Business Sector:	Nanofabrication/photonics
Employees:	17
Founded:	2006
Web Site:	www.abeamtech.com
Contact Info:	5286 Dunnigan Ct. Castro Valley, CA 94546 support@abeamtech.com

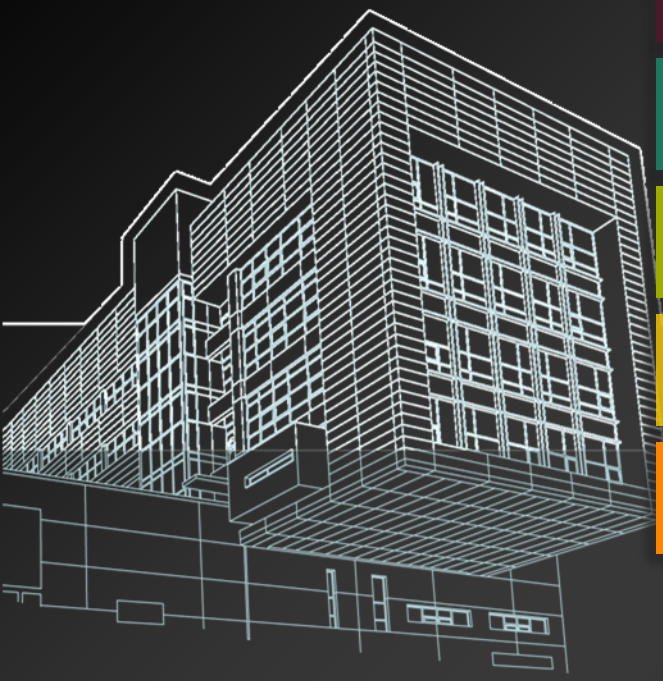
Projects

- 3 joint user projects completed from 2007
- Spectrometer-on-chip: integrated optical chip for high resolution spectroscopy
- New photonic chip to increase the brightness of high-power laser diodes
- BEAMETR: Nano-patterns for automatic measurement of e-beam size

Outcomes

- BEAMETR is a commercial product
- A prototype of high resolution spectrometer-on-chip was successfully developed
- 2011 US-Air Force STTR project: High-resolution spectrometer chip
- 2012: New joint proposal on nanoimprinting of inorganic materials

THE MOLECULAR FOUNDRY AT LBNL



TMF – 1 of 5 DOE NSRCs co-located at 6 National Labs

A DOE User facility for basic nanoscale research

Our User Program is robust and encourages collaboration with industry, government and academia

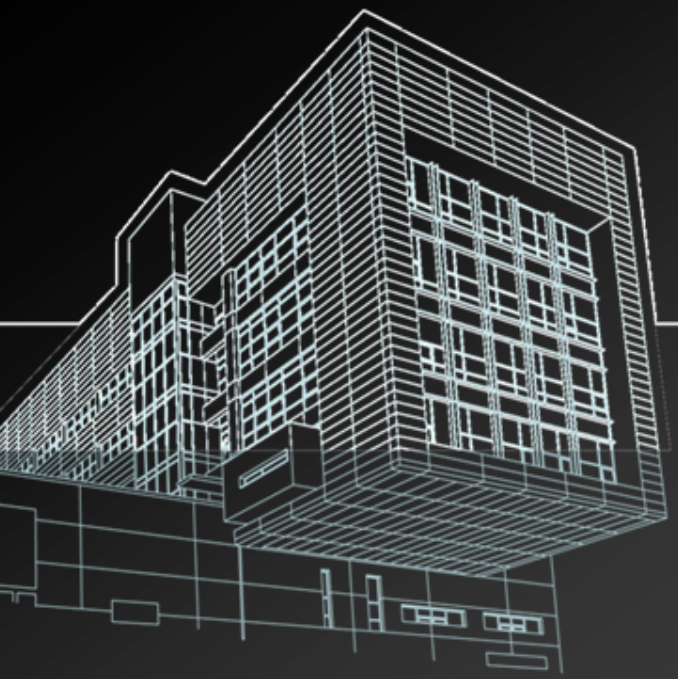
TMF integrates a strong nanoscale safety and health culture into all our user projects

TMF user statistics show strong growth for us at multiple interfaces of basic nanoscience research

The Molecular Foundry wants you...!

Lawrence Berkeley National Laboratory

The Molecular Foundry



Next user proposal deadline: January 15, 2012

DAVID BUNZOW

MOLECULAR FOUNDRY

USER PROGRAM MANAGER

Email: dabunzow@lbl.gov

Phone: 510-486-4574

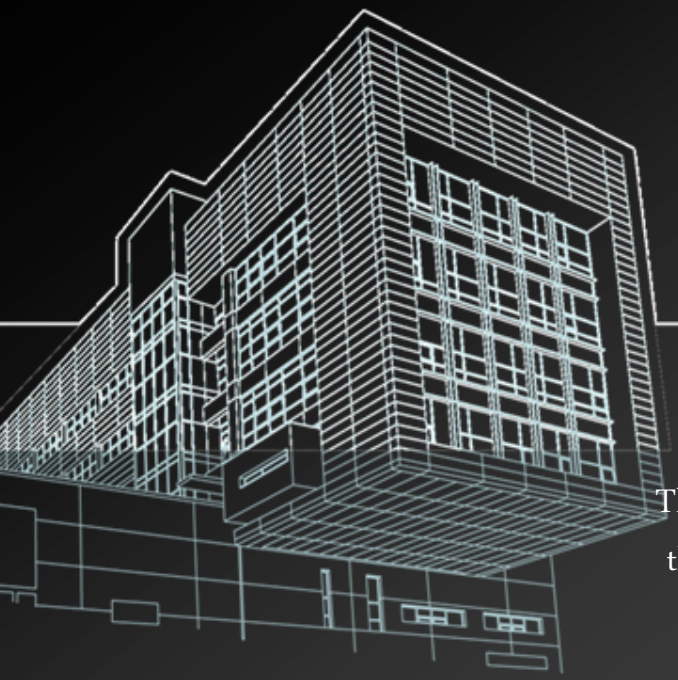
Fax: 510-486-7424

Cell: 701-541-2354

Did I fail to mention the otherwise tremendous not-too-shabby view?

Lawrence Berkeley National Laboratory

The Molecular Foundry



Through access to state-of-the-art instruments, materials, technical expertise and training, the Molecular Foundry provides researchers with the tools to enhance development and promote understanding of the synthesis, characterization, and the theory of nanoscale materials

ACKNOWLEDGEMENT

"Work at the Molecular Foundry is supported by the Office of Science, Office of Basic Energy Sciences, of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231."